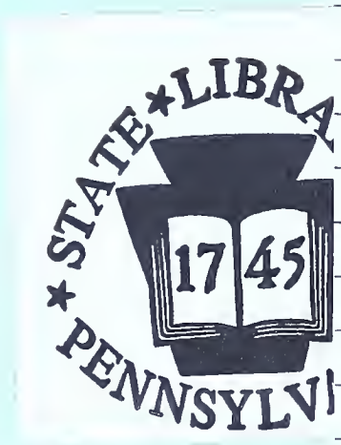
PLAN OF STUDY

MANAGING SEDIMENT AND NUTRIENTS IN THE SUSQUEHANNA RIVER BASIN

SUSQUEHANNA RIVER BASIN COMMISSION

June 1993

Publication No. 153



PLAN OF STUDY

MANAGING SEDIMENTS AND NUTRIENTS IN THE SUSQUEHANNA RIVER BASIN

BY

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Prepared under a grant from

The Chesapeake Bay Commission
Hon. Jeffrey Coy, Chairman

SUSQUEHANNA RIVER BASIN COMMISSION

The Susquehanna River Basin was created as an independent agency by a federal-interstate compact* among the states of Maryland, New York, Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to effect coordinated planning, conservation, management, utilization, development and control of basin water resources among the government and private sectors.

**Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).*

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ACKNOWLEDGMENTS

We wish to acknowledge the many contributions of the members of the Sediment Management Study Technical Advisory Committee to the production of this plan of study. Representing state and federal agencies, the utility companies, the scientific community, and the Chesapeake Bay Commission, the committee members generously shared their time and expertise to guide and enhance the plan. We will continue to look to the committee for guidance as the study progresses.

We especially wish to publicly acknowledge and thank the Chesapeake Bay Commission for underwriting the cost of preparing the plan of study.

STATEMENT OF THE PROBLEM

The goal of the Chesapeake Bay Program is a 40 percent reduction in the controllable total nitrogen and total phosphorous loads reaching the Bay. As the largest tributary to the Bay, the Susquehanna River Basin has an important contribution to make in this effort.

The Susquehanna is unique in that three hydropower dams are located in the lower reach of the river (see Figure 1). Recent studies[1] suggest that the reservoirs behind the dams trap about 2.4 million tons of the 3.3 million tons of sediment which wash down the river in an average year.

Bound to the sediment is some 9.1 million pounds of phosphorus, 4 million pounds of which is trapped behind the dams. Scientists estimate that the sediment storage capacity in the reservoirs will be filled in the next 15 to 20 years. If no action is taken, the sediment and phosphorus loads reaching the Bay will increase by factors of 2.7 and 1.3, respectively, over the next two decades.

Increases in the phosphorus load of this magnitude will negate any gains achieved by the Commonwealth under its part of the Chesapeake Bay Program nutrient reduction strategy. This conclusion assumes average flows. A repeat of a storm event of the magnitude of Hurricane Agnes could scour large quantities of sediment from the reservoirs and deposit it and the adsorbed

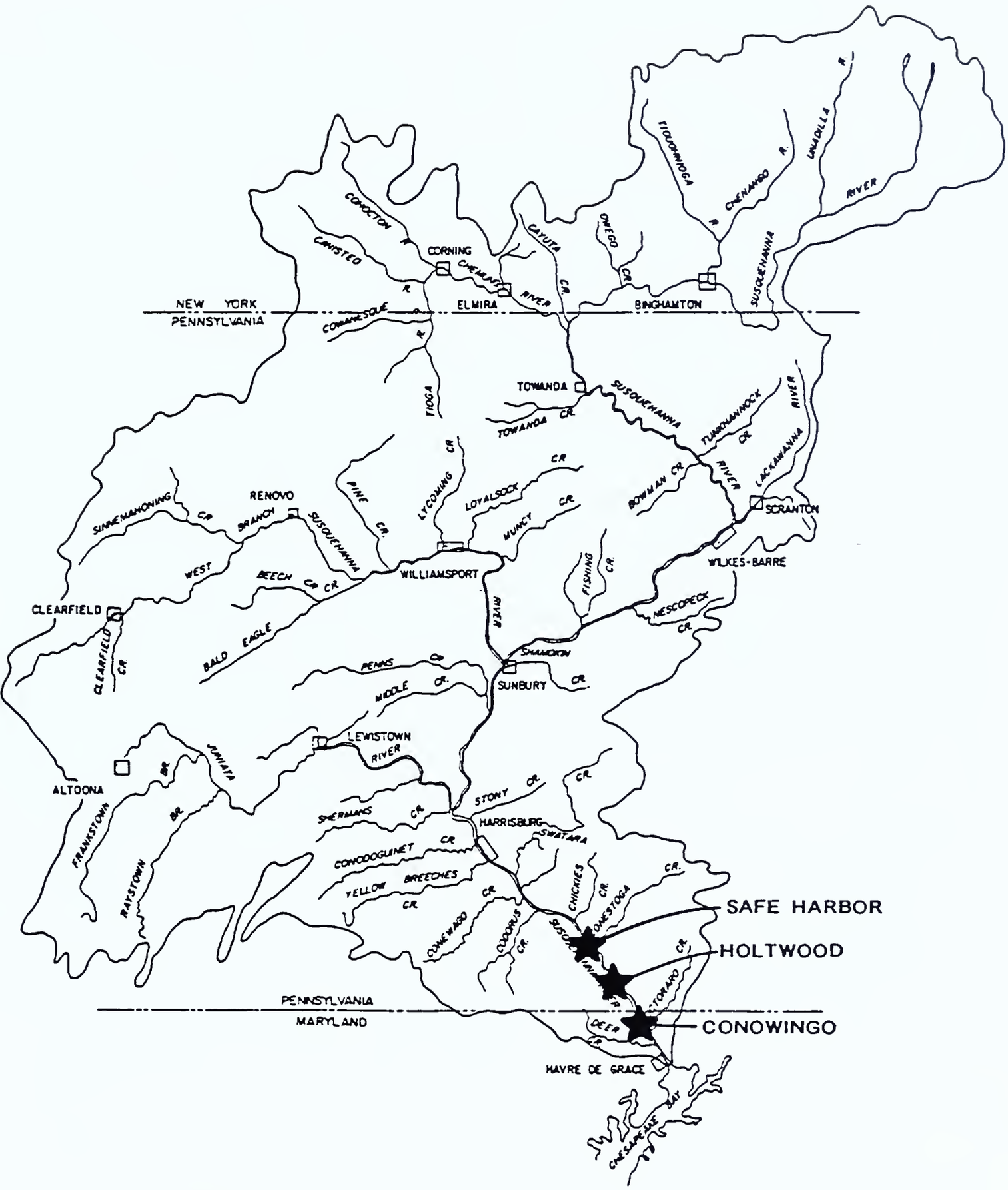

Figure 1. Susquehanna River Basin Showing the Location of the Three Major Hydropower Facilities

phosphorus in the upper Bay. (Analyses of samples taken by USGS during the high flow event of April 1993 are expected to provide useful insights into the scouring phenomenon.)

Note that nitrogen is not an issue here. Since nitrogen compounds are more water soluble, only 7 million of the 154 million pounds that are carried downstream annually are trapped by the reservoirs.

The present study will examine the following aspects of the trapped sediment.

-- Review all of the relevant literature so as to better understand the relationship between the trapped nutrients/sediment and materials carried to the Bay. (Given time and budgetary constraints, quantification of any impacts on the waters of the Bay is not within the scope of this study.)

-- Seek cost-effective and technologically feasible means of reducing the quantity of trapped materials scoured from the reservoirs and transported to the Bay during high flow events.

-- Seek innovative means (over and above current point source reductions and land-oriented nonpoint source BMP's) to reduce nutrient/sediment materials entering the water course and reaching the Bay.

BACKGROUND

A. Description of Study Area

The Susquehanna River drains an area of 27,500 square miles in south-central New York, the central half of Pennsylvania and a small area in Maryland. It is the largest tributary to the Chesapeake Bay. Fifty percent of the freshwater inflow to the Bay comes from the Susquehanna.[2]

Based on Bay monitoring and modeling results, it is estimated that 28 percent of the controllable load of total nitrogen and 27 percent of the controllable total phosphorus load entering the Bay come from the Susquehanna Basin.[3] SRBC monitoring results indicate that approximately 3 million metric tons of suspended sediment reach the main stem of the Susquehanna River annually, with approximately 0.9 million tons delivered to the Bay.[4]

Three hydroelectric facilities, with a combined generating capacity exceeding 1,000 megawatts, are located in the lower 35 miles of the Susquehanna River. Each dam acts as a sediment trap. The Harrisburg, Pa. office of the U.S. Geological Survey is completing a study of sediments and the associated nutrients trapped behind the hydropower dams.[1]

The study estimates 40 million metric tons of sediment have been deposited behind the dams since Hurricane Agnes occurred in 1972. It also estimates in 20 years the reservoirs will be full and sediment trapping efficiency and capability will decline.

B. History of the Chesapeake Bay Program

The importance of the Chesapeake Bay to the nation was demonstrated when Congress approved language, submitted by U.S. Senator Charles Mathias of Maryland in the Environmental Protection Agency FY-1976 appropriation to initiate a 6-year, $27 million project to study the Chesapeake Bay. The study sought to determine the nature of and cause for the apparent decline of the world's most productive estuary.

The study concluded the Bay is being affected by nutrient enrichment, sedimentation, toxic chemicals, and by man-made alterations. These findings led to a new state/federal/District of Columbia joint agreement to clean up the Bay.

In 1987 Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency signed the Chesapeake Bay Agreement, a covenant to reduce the nutrients entering the Bay from point and nonpoint sources. The initial target was a 40 percent reduction in the controllable nitrogen and phosphorus entering the main stem of the Bay. It was also agreed to reevaluate the 40 percent goal in 1991.

The 1991 reevaluation produced these important conclusions:

1. Water quality and aquatic habitat in the Bay have improved.

2. Efforts to control nonpoint sources of pollution need to be intensified, especially in the tributary rivers.

3. Existing pollution control technologies may be at the limits of their capability to achieve the 40 percent nutrient reduction target.

In response to the reevaluation findings, the Chesapeake Bay Executive Council amended the Bay Agreement in 1992 to include the following items, among others:

1. Recognition of the importance of extending the pollution-control efforts to the Bay's tributary rivers.

2. A commitment to seek improved, cost-effective technologies that will achieve additional nutrient reductions.

GOALS AND OBJECTIVES

The goal of the proposed study is to find a mix of environmentally safe and cost-effective management practices that minimize the quantity of nutrient-laden sediments transported by the Susquehanna River and delivered to the Bay. Particular attention will be paid to the large quantities of these materials trapped behind the hydroelectric facilities located in the lower reach of the Susquehanna River.

The Pennsylvania Department of Environmental Resources currently is developing a nutrient-reduction strategy for the

lower Susquehanna River Basin, as mandated by the 1992 amendments to the Chesapeake Bay Agreement. The study findings may assist the department in developing the strategy by suggesting innovative nutrient reduction options beyond the conventional land-based best management practices.

The study has the following objectives:

1. Review the literature relating to the sediments and adsorbed nutrients trapped by the dams in the lower Susquehanna River.

2. Assemble data about the trapped materials from the utilities, the USGS and other sources.

3. Assess any potential impact of the sediments/nutrients on the Chesapeake Bay.

4. Identify alternative technologies for reducing sediment transport to the Bay. The following listing is illustrative of the range of alternatives that can be considered:

-- Removal of sediments trapped behind the lower Susquehanna dams by dredging.

-- Fix in place the existing accumulation of sediments behind the dams, using physical or chemical means, to

eliminate the potential for a reoccurrence of the flushing of huge quantities of sediments to the Bay such as occurred with Tropical Storm Agnes in 1972.

-- Investigate controlled release of existing and future sediments stored in the reservoirs to minimize the effects of catastrophic storm events.

-- Determine the effectiveness and potential role of an on-the-land sediment management program. This may include various conservation measures such as: constructing small (farmstead size) sediment trapping structures on the farm or in small watersheds.

-- Investigate the potential and desirability of increasing the sediment trapping efficiency in existing upstream federal and state flood control/water supply reservoirs.

5. Develop cost coefficients for each of the technologies considered for use in the cost-effectiveness analysis.

6. Suggest cost-effective alternatives to Pennsylvania Department of Environmental Resources for use in their nutrient reduction strategy for the impounded reaches of the lower Susquehanna River.

ORGANIZATION AND MANAGEMENT OF THE STUDY

An SRBC staff member has been designated as study manager. He will establish and maintain liaison with a Technical Advisory Committee (TAC). The study manager will monitor adherence to the plan of study as the work progresses, prepare scheduled reports, prepare the final study report, and provide overall management to achieve the stated goals of the study within a predetermined schedule and budget.

The TAC is the vehicle by which various interests are linked to the study as it progresses. It will play a vital role in the review and development of the plan of study by providing a range of technical and institutional perspectives, reviewing study progress as to technical validity, and providing comments on the findings and recommendations of the draft study report. While not cast as a policy making body, the TAC will be of valuable assistance in the development of a strategy for managing sediments in the Susquehanna River Basin so as to minimize their impact on the Bay.

SCOPE OF WORK

The proposed scope of work to be carried out to meet the goals and objectives of this study is as follows:

I. Present State of Knowledge

A. Literature review

1. Sediment generation
2. Sediment and nutrient storage in the reservoirs
3. Sediment/nutrient/water column interactions--differences between Bay and reservoirs
4. Technologies for reducing effects of sediments and nutrients

B. Impacts of present programs

1. Elements in current strategy
2. Nutrient reductions with existing efforts

C. Identify knowledge gaps

1. Describe those areas in which the level of understanding of relevant chemical/physical/biological processes limit the analyses in some way.

II. Efforts to Reduce the Knowledge Gaps

Design and, where possible within budgetary and time constraints, carry out studies that will enhance the quality of the sediment management study. Such efforts may include but are not limited to the following areas of inquiry.

-- Increased understanding of the sediment/nutrient/water column interactions in the reservoirs.

-- Improved measurement of annual accumulation of sediment and nutrients (coordinate with USGS-Harrisburg and their second study for Pa. DER).

-- Assess the impact of high-flow events of various magnitudes on sediment stored in reservoirs and transported to the Bay.

III. Assessment of the Alternative Mitigation Measures

The study manager, in consultation with other SRBC staff and members of the TAC, will gather information for the alternative mitigation technologies mentioned previously, and any others that may be identified subsequently. The information collected will include:

- Detailed description of the technique;
- Technical efficiency, i.e., impact per unit of effort;
- Availability in or adaptability to the study region;
- Unit costs of the technology; and
- Strengths and limitations of each.

Based on the information gathered, the techniques will be assessed for their potential to contribute to a reduction in the sediments and nutrients reaching the Bay. Those found suitable will be utilized in the least-cost analysis described below.

IV. A Cost Minimizing Framework

A. Specifying the analytical framework

1. A constrained cost minimization approach
2. Specification of technical parameters
3. Specification of cost coefficients

B. Results of analyses

1. Least-cost solutions
2. Sensitivity analysis

C. Implications of findings

V. Summary and Recommendations

STUDY SCHEDULE AND COST

The entire study process, beginning with the adoption of a final plan of study and continuing through the various investigations and preparation of a final report, is expected to take eighteen to twenty-four months. Costs for the first twelve months of the study are expected to be on the order of $150,000.

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